

Economic Impacts:

Options for SNAP Decision on n-Propyl Bromide

U. S. Environmental Protection Agency

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## *1. Executive Summary*

EPA's Office of Air and Radiation has analyzed the potential economic impacts of different regulatory options for regulation of n-propyl bromide (nPB) under the Significant New Alternatives Policy (SNAP) program. We focused on regulatory options restricting the content of the contaminant isopropyl bromide in nPB formulations. The two content levels we evaluated for impacts on small businesses are (A) 0.05% isopropyl bromide and (B) 0.025% isopropyl bromide. Option A is the option in the proposed rule.

The benefits of the proposal outweigh the costs. Costs are divided into costs of the regulatory condition and the recommended acceptable exposure limit. Costs of the regulatory condition only impact the adhesives, coatings, and ink sector. Option A, the regulatory proposal, is less costly than Option B. The recommended AEL creates a cost savings for the solvent cleaning sector, a slight cost for the aerosol sector, and a cost for the adhesives, coatings, and inks sector. EPA finds that the overall cost of the regulatory requirement is no more than \$2.9 million per year. Implementing both the recommendations and requirements of the proposal is calculated to result in a cost between a savings of \$ -0.9 million and a cost of \$+8.1 million, while health benefits could be as high as \$ 270 million per year.

## *2. Characterization of Markets for n-Propyl Bromide*

There are three industrial sectors under the SNAP program that currently use n-propyl bromide: non-aerosol solvent cleaning, aerosols, and adhesives, coatings, and inks. Within these sectors, the following end uses currently use nPB: metals cleaning, precision cleaning, electronics cleaning, aerosol solvents, and adhesives. In addition, the SNAP program has received incomplete submissions for use of nPB as a foam blowing agent and as part of a fire suppressant blend. These last two are outside the scope of the proposal on nPB.

In addition to the sectors covered by the SNAP program, other industries use nPB. Chemical companies have used nPB as a feedstock for years. Some clothing manufacturers use n-propyl bromide for spot cleaning on new clothes. In the future, nPB could be used for dry cleaning in areas where smog, and hence, smog precursors that are volatile organic compounds, are not of concern. There is anecdotal evidence that in Mexico, companies use nPB for chemically "welding" together plastic parts of toys. These applications are beyond the scope of the SNAP program.

Solvent cleaning is performed in a large variety of manufacturing uses. Metal cleaning is commonly done to remove grease, oil, and metal filings from a number of applications where metal parts are coated, cut, plated, or stamped. Electronics cleaning removes primarily excess solder flux from printed circuit boards and other electronic equipment. Precision cleaning is removal of dirt, grease, oil, solder flux, and other impurities where the degree of cleanliness is essential to the value of the end product. The primary industrial categories performing non-aerosol solvent cleaning are in the following subsectors under the North American Industrial Classification System (NAICS):

**Table 2-1: NAICS Subsectors Performing Solvent Cleaning**

NAICS Subsector Code	NAICS Subsector Description	Example Application of Solvents
332	Fabricated Metal Product Manufacturing	Cleaning off electroplated metals
333	Machinery Manufacturing	Cleaning filings and grease off ball bearings
334	Computer and Electronic Product Manufacturing	Cleaning solder flux from printed circuit boards
336	Transportation Equipment Manufacturing	Cleaning grease from metal parts in motor vehicles
337	Furniture and Related Product Manufacturing	Cleaning grease from metal furniture parts

Estimates of the number of nPB solvent end users vary from 500 end users (email to W. Kenyon from RRage1, 2001) to up to 2500 (IBSA, 2002). It is not clear if the latter estimate is only for the non-aerosol solvent cleaning market, or if it incorporates other sectors.

Businesses in this sector generally produce high-value products that cost considerably more than the cost of cleaning. The NAICS subsector with the lowest priced products is NAICS subsector 337, Furniture and Related Product Manufacturing. The average annual value of shipments per business in each of these subsectors, based on the number of employees at the business, is tabulated below in Table 2-2. (We use the value of shipments from the 1997 Economic Census as a proxy for sales or revenues.)

**Table 2-2: Average Value of Shipments in NAICS Subsectors Performing Solvent Cleaning, by Number of Employees at Business**

Number of Employees at Business	Average Value of Shipments per Company (\$) by NAICS Subsector Code				
	332, Fabricated Metal Products	333, Machinery	334, Computer and Electronic Products	336, Transportation Equipment	337, Furniture and Related Products
1-4	174,832	230,806	279,683	d	141,654
5-9	d	766,045	903,756	d	501,193
10-19	1,393,019	d	1,925,077	1,897,347	1,102,104
20-49	3,596,222	d	4,270,554	4,190,678	2,744,633
50-99	9,283,654	10,429,360	10,440,847	10,140,871	6,908,332
100-249	24,566,631	25,781,244	d	27,861,502	17,898,851
250-499	55,392,738	64,822,617	d	69,529,351	d
Average--All Small Businesses in Subsector	<b>3.2 million</b>	<b>4.2 million</b>	<b>2.4 million</b>	<b>8.9 million</b>	<b>1.7 million</b>
Average--All Businesses in Subsector	3.9 million	8.9 million	25.2 million	44.6 million	3.1 million
Average--All Small nPB Users in NAICS Code	5.0 million	7.2 million	7.5 million	12.7 million	4.4 million

Note: "d" designates "Data withheld to avoid disclosing data of individual companies; data are included in higher level totals."

Most of the nPB used as an aerosol solvent is used for cleaning electrical or electronic equipment and for aerospace maintenance cleaning. These correspond to the following NAICS designations:

**Table 2-3: NAICS Subsectors Using nPB as an Aerosol Solvent**

NAICS Code	NAICS Category Description	Example Application of Solvents
334	Computer and Electronic Product Manufacturing	In-place cleaning of adhesives or solder flux in installed electronic equipment
336	Transportation Equipment Manufacturing	In-place cleaning coatings or grease from metal parts in airplanes

Other minor uses of nPB as an aerosol solvent include lubricants and cleaning sprays for spinnerettes used in the production of synthetic fibers. EPA's estimate of the number of nPB aerosol users is from 1000 to 5000.

To date, EPA has found the following applications of nPB as a carrier solvent for adhesives:

**Table 2-4: NAICS Categories Using nPB as a Carrier Solvent in Adhesives**

NAICS Code	NAICS Category Description	Example Application of Adhesives
326150	Urethane and other foam product (except polystyrene) manufacturing	Sticking pieces of foam together during foam fabrication to make cushions
336360	Motor vehicle seating and interior trim manufacturing	Assembling aircraft seating
337110	Wood kitchen cabinet and counter top manufacturing	Glueing high-pressure laminant counter-tops in kitchens
337121	Upholstered household furniture manufacturing	In foam cushions
337124	Metal household furniture manufacturing	In foam cushions

In addition, nPB-based adhesives are also used for prefabricated homes (trailers) and for cushions in pet beds (Notes from October 17, 2001 meeting with HSIA). These uses are relatively small compared to the NAICS codes listed above. In the past, some floor-laying contractors in the southeastern U.S. used nPB-based adhesives to glue wood or tile on concrete floors. However, Franklin International withdrew its nPB-based adhesive from this market due to regulatory uncertainty (conversation with Amanda Thomas, Franklin International, 2001). Estimates of the number of adhesives users range from 40 (Poly Systems, 2002) to 280 (ICF Consulting, 2001). Adhesive users tend to be small businesses. Larger companies may choose to use the least expensive adhesives, which are flammable; the large foam fabricators can afford to make major capital expenditures for fire-proofing and explosion-proofing needed with flammable adhesives. Smaller foam fabricators are more likely to use nPB as an adhesive because they have fewer resources available to put into capital expenditures for fire-proofing or to put into a search for water-based adhesives that require a process change (Imperial Adhesives call, 2001).

**Table 2-5: Typical Value of Shipments in NAICS Categories  
Using nPB as a Carrier Solvent in Adhesives, by Number of Employees at Business**

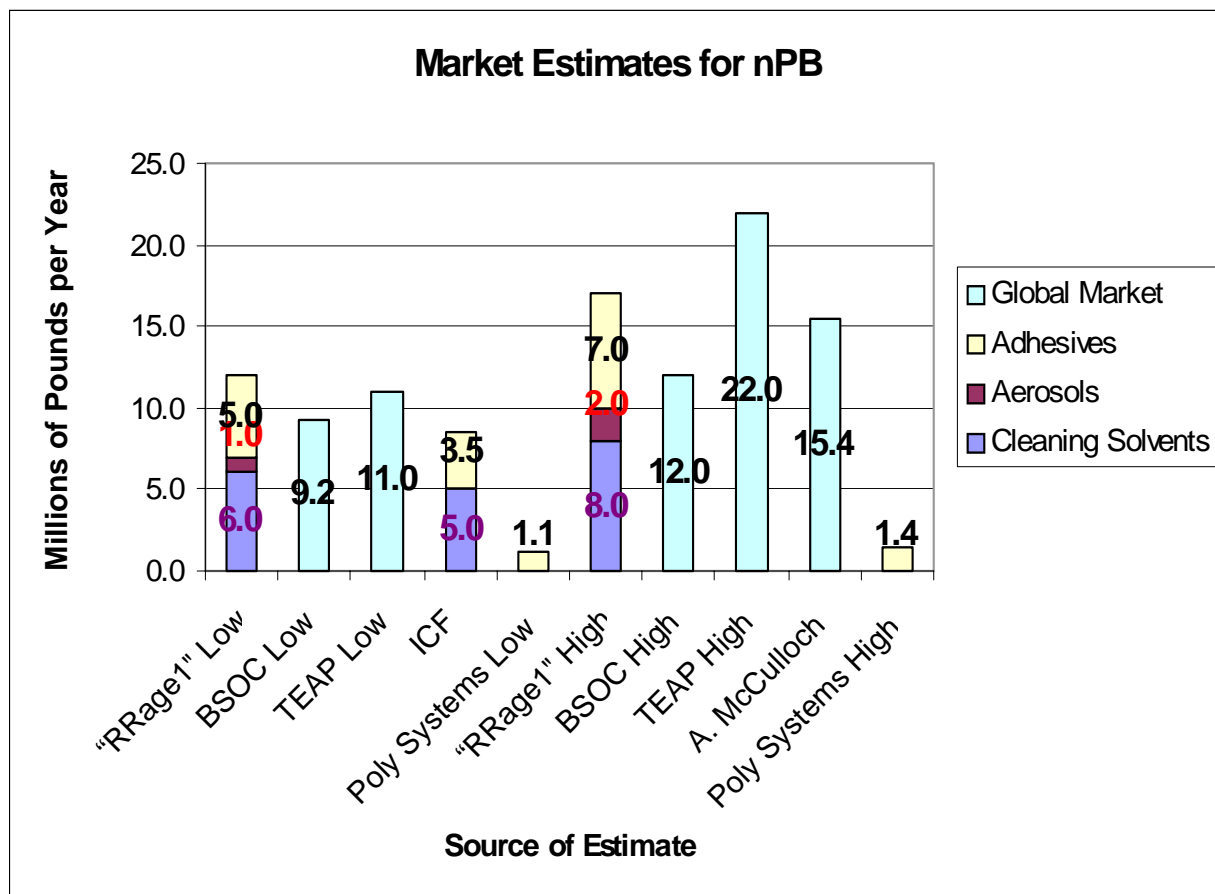
Number of Employees at Business	Average Value of Shipments per Small Company (\$) by NAICS Code				
	337121 Upholstered household furniture	337110 Wood kitchen cabinet and counter tops	326150 Urethane and other foam products (except polystyrene)	336360 Motor vehicle seating and interior trim	337124 Metal household furniture
1-4	135,545	135,046	287,744	174,500	170,820
5-9	428,646	457,310	1,211,200	532,875	582,725
10-19	913,225	1,015,967	2,537,028	2,490,455	1,299,671
20-49	2,582,340	2,326,857	5,892,653	3,901,979	3,730,479
50-99	5,680,148	5,655,585	11,608,984	8,981,786	7,522,129
100-249	14,832,151	16,139,988	26,480,552	44,153,730	16,911,474
250-499	d	47,943,433	59,104,111	100,579,000	33,330,714
<b>Average--All Small Businesses in NAICS Code</b>	<b>3.3 million</b>	<b>0.9 million</b>	<b>9.4 million</b>	<b>18.3 million</b>	<b>4.1 million</b>
Average--All Small nPB Users in NAICS Code	4.9 million	2.4 million	10.3 million	5.8 million	16.9 million
Average--All Businesses in NAICS Code	4.9 million	1.1 million	10.1 million	29.1 million	6.0 million

The BSOC estimates that the U.S. market for nPB is roughly 40% of the global nPB market. Estimates of the number of nPB end users vary from 600 (email to W. Kenyon from RRage1, 2001) to 2500 (IBSA, 2002). It is not clear if the latter estimate is only for the non-aerosol solvent cleaning market.

There are manufacturers of nPB in the U.S., Israel, China, India, the U.K., France, Japan, and the Netherlands (TEAP, 2001). There is currently only one U.S. company that manufactures its own nPB, Albemarle Corporation. At least 17 multinational companies blend or package nPB, and roughly 70 vendors world-wide advertise sale of nPB or equipment in which to use nPB (TEAP, 2001). There are five major nPB solvent manufacturers (Poly Systems, Enviro Tech International, Petroferm, AmeriBrom, Tulstar) and four major nPB-based adhesive manufacturers in the U.S. (TACC Adhesives, Imperial Adhesives, Mid-South Adhesives, Pearson Stevens). There are another 60 or so small providers in the U.S. of specialty products, including nPB, and 80 or so distributors and marketing representatives selling products using nPB (IBSA, 2002). Approximately 20 to 25 companies prepare aerosol formulations with nPB (email to W. Kenyon from RRage1). Very few of these companies manufacture only products using nPB; most produce a number of product lines. Estimates for sales of nPB in the SNAP sectors vary. Figure 1 and Table 2-6 summarize estimates available to EPA by sector.

**Table 2-6: Estimates of Markets for nPB**

Source of Estimate	Amount of nPB Used Annually, 2000-2002 (millions of pounds)			
	Cleaning Solvents	Aerosols	Adhesives	Global Market
Email to W. Kenyon ("RRage1") (2001)	6 to 8	1 to 2	5 to 7	12 to 15
Brominated Solvents Consortium (BSOC, 2001)				9.2 to 12
U. N. Technical and Economic Assessment Panel (TEAP, 2001)				11 to 22
A. McCulloch (2001)				less than 15.4
ICF Consulting (2001)	5		3.5 (U.S. only)	
Poly Systems (2002)			1.1 to 1.4	





**Table 2-7: Estimates of Number of Affected Businesses and Workers**

Industrial Sector	Number of businesses affected	Number of small businesses affected	Number of workers exposed
Solvent cleaning	500 to 2500	500 to 2300	1000 to 8500 (2 to 5 per company)
Aerosols	1000 to 5000	900 to 4750	2000 to 25,000 (2 to 5 per company)
Adhesives, coatings and inks	40 to 280	40 to 280	320 to 1200 (4 to 8 per company)
All	1540 to 7580	1440 to 7330	3320 to 34,700

Table 2-7 summarizes the total number of businesses and the number of small businesses estimated to use nPB by industrial sector. The table also estimates the number of workers estimated to be exposed to nPB. The number of businesses using nPB is based upon estimates from IBSA(2002) and MicroCare Corporation (T. Tattersal, 2003), and information provided to Dr. William Kenyon (email to W. Kenyon from RRage1, 2001).

### 3. *Economic Impacts of Regulatory Options*

EPA considered the costs of two regulatory options with the two-fold purpose of considering total economic impacts on the regulated communities and potential significant adverse financial impacts on small businesses. Most users of nPB are small businesses, and in the case of adhesives use, virtually all users are small businesses.

#### 3.1 Regulatory impacts on the solvent cleaning sector

Several suppliers of nPB have said that it costs from \$3 to 5 per pound when used in the solvent cleaning market (Presentation to 16<sup>th</sup> OORG meeting—Solvents Sector, May 2, 2000, Singh email). One of our sources of information, a producer of nPB solvent formulations, informed us that manufacturers of nPB could absorb the costs of restricting the content of isopropyl bromide. Further investigation supports this conclusion.

Many manufacturers already produce nPB containing less than 0.025% isopropyl bromide by weight. Formulators have stated that most nPB contains less than 0.05% isopropyl bromide (Memo from R. Morford, Enviro Tech International, to M. Shelby, CERHR; Poly Systems, 2002). ASTM D6368-00, Standard Specification for Vapor-Degreasing Grade and General Grade *normal*-Propyl Bromide, the ASTM standard for production of nPB for use in vapor degreasing, limits the content of isopropyl bromide to 0.1% by weight or less. Thus, nPB is available in a range of purity levels, and producers of the purer nPB formulations are competing with producers of less pure formulations. We concluded that the producer was correct that restricting the content of isopropyl bromide as low as 0.025% by weight would not result in a cost increase for end users in this sector.

Based on the information from the solvent supplier about suppliers' ability to absorb price increases, the two regulatory options will not have a cost impact on businesses in the non-aerosol solvent sector. As a result, there also would not be a significant impact on small businesses in this sector.

#### 3.2 Regulatory impacts on the aerosol sector

As for the non-aerosol solvent cleaning sector, we would expect that formulators and manufacturers of nPB could absorb the costs of restricting the content of isopropyl bromide for use in aerosol solvents. As a result, there also would not be a significant impact on small businesses in this sector.

In the aerosol solvent end use, users consider trade-offs of using inexpensive, flammable aerosol solvents (for example, hydrocarbons) or using more expensive, less aggressive, non-flammable aerosol solvents (for example, hydrofluoroethers and hydrocarbons). Thus, nPB-based aerosol solvents would still be cost-competitive with the more expensive non-flammable aerosol solvents. For example, hydrofluoroethers and hydrofluorocarbons currently cost two to three times as much per pound as nPB.

### 3.3 Regulatory impacts on the adhesives, coatings, and inks sector

#### *Bottom-up analysis*

ICF Consulting (ICF) developed a sophisticated spreadsheet model for EPA under contract to determine impacts on small businesses in the adhesive sector. The spreadsheet model calculates the net present value and annualized costs to an individual user in different NAICS codes for complying with each regulatory option using various assumptions. The spreadsheet model uses data from the 1997 Economic Census to compare the annual compliance costs against average annual value of shipments, a proxy for the value of sales.

From this information, we analyzed the impact of both regulatory options. Using this “bottom up” approach based on expenses to each user, we calculated a cost of approximately \$2.9 million per year at current usage under Option A (limit iPB content to 0.05% by weight). Under Option B, where the iPB content of nPB formulations is limited to 0.025% by weight, we calculated a cost of approximately \$ 5.3 million per year. Option A is the regulatory option in the proposed rule. For a detailed look at the analysis by NAICS code, see Appendix A to this report.

**Table 3-1: Comparison of Costs under Regulatory Options Considered  
 (“Bottom-Up” Analysis)**

Regulatory Option	Average annual cost to an adhesive user (2000 \$)	Annual cost to the user community (2000 \$)
Option A (iPB $\leq$ 0.05%)	\$10,400	\$ 2.9 million
Option B (iPB $\leq$ 0.025%)	\$18,900	\$ 5.3 million

#### **Assumptions**

Our analysis incorporates the following assumptions:

##### Solvent cost assumptions

- The current cost of nPB is \$2.00 per pound in the adhesives sector (9/24/2001 email from R. Singh). This is a conservative assumption, since prices for nPB solvent fluctuated between \$1.30 and \$2.00 per pound in 2001.
- Limiting the iPB concentration to 0.05 percent would result in an increase in the price of nPB to \$2.88 per pound.
- A restriction on iPB concentration of 0.025 percent would yield an 80 percent aggregate increase in nPB price (i.e., further raising the cost of nPB to \$3.60 per pound).

### Amount of solvent

- Adhesives manufacturers used about 3.5 million pounds of nPB to produce adhesives in 2000 in the U.S.
- All users of nPB will continue to use nPB-based adhesives, as opposed to switching to an alternative. This is a conservative assumption, because it does not consider that some users may find it cheaper to use an alternative adhesive as the price of nPB-based adhesives rise.

### Controls

- End users install no new equipment for controlling emissions of nPB. This is because the affected businesses are already using nPB and the proposed regulation does not require the users to install any new control equipment.
- End users make no effort to optimize use of adhesives to minimize costs.

### nPB adhesives market

- Businesses do not pass on their cost increases to consumers.
- The model uses information from the 1997 Economic Census to list the number of companies in each relevant NAICS code by consulting with an industry expert. Table 3-1 provides these estimates in detail.
- ICF's estimates from industry experts indicate that less than 2.5% of all businesses in the major NAICS codes use nPB-based adhesives.
- All users of nPB-based adhesives are small businesses.

EPA also evaluated the typical impacts on small businesses. Table 3-3 below shows average cost impacts on small businesses using nPB-based adhesives, both as an annual cost and as a percentage of sales (value of shipments). For all of the NAICS codes, the impact of Option A (iPB content  $\leq 0.05\%$ ) was less than 0.4%, and for most of the codes, the impact was less than 0.1% of sales. Option B (iPB content  $< 0.025\%$ ) had a somewhat larger impact, approaching 0.6% for Motor Vehicle Seating and Interior Trim Manufacturing.

In a separate analysis, the Agency considered how many small businesses might experience a significant adverse financial impact as a result of the regulatory use condition. That separate analysis found that no more than thirteen small businesses, and possibly none, would experience an impact of greater than 1.0 percent of sales as a result of a requirement for 0.05% iPB or less in nPB formulations. That analysis also found that 32 to 38 small business would experience an impact of greater than 1.0 percent of sales due to a requirement for 0.025% iPB or less in nPB formulations. The details of this analysis by NAICS code and size category of business are in Appendix A.

**Table 3-2. Estimated Number of Entities Using nPB-Based Adhesives  
by NAICS Code and Category**

NAICS Code	Business Category	Number of Businesses	Number of Businesses Using nPB-Based Adhesives
336360	Motor Vehicle Seating and Interior Trim Manufacturing	336	21
326150	Urethane and Other Foam Product Manufacturing	656	172
337121	Upholstered Household Furniture Manufacturing	1,674	49
337110	Wood Kitchen Cabinet and Counter Top Manufacturing	7,948	27
337124	Metal Household Furniture Manufacturing	409	11
<b>Total</b>	<b>-</b>	<b>11,708</b>	<b>280</b>

Source: 1997 Economic Census, ICF 2001.

**Table 3-3. Estimated Regulatory Impacts on Small Businesses Using nPB-Based Adhesives by NAICS Code and Category**

NAICS Code	Business Category	Typical Cost of Compliance Per Small Business Using nPB		Average Annual Value of Shipments per Small Business in NAICS Category	Typical Cost of Compliance Per Small nPB User as a Percentage of Sales	
		Option A	Option B		Option A	Option B
336360	Motor Vehicle Seating and Interior Trim Manufacturing	\$64,900	\$118,000	\$18.3 million	0.35%	0.64%
326150	Urethane and Other Foam Product Manufacturing	\$ 5,180	\$ 15,940	\$9.4 million	0.06%	0.17%
337121	Upholstered Household Furniture Manufacturing	\$ 930	\$ 1690	\$3.3 million	0.03%	0.05%
337110	Wood Kitchen Cabinet and Counter Top Manufacturing	\$ 340	\$ 620	\$0.9 million	0.04%	0.07%
337124	Metal Household Furniture Manufacturing	\$ 580	\$ 1060	\$4.1 million	0.01%	0.03%
<b>Sector Average</b>	-	<b>\$ 8,220</b>	<b>\$ 18,920</b>		<b>0.10%</b>	<b>0.24%</b>

Option A: isopropyl bromide content of nPB  $\leq$  0.05%

Option B: isopropyl bromide content of nPB  $\leq$  0.025%

### Possible impact of an unacceptability determination for adhesives

EPA's proposed rule takes comment on whether nPB should be acceptable, subject to use conditions, or unacceptable. ICF Consulting also analyzed the possible cost impact if nPB were to be unacceptable in the adhesives end use. The study assumed that adhesives users would need to switch to another type of adhesive using either water, acetone, or methylene chloride as the carrier for the adhesive solids.

ICF's analysis made the following cost assumptions, based on case studies from conversions in the foam fabrication industry (IRTA, 2000):

Solvent cost assumptions—cost/gallon of adhesives

- nPB—\$17/gal
- water-based—\$7/gal
- methylene-chloride based—\$7/gal
- flammable (acetone)—\$6/gal

Solvent use assumptions:

Amount of adhesive use varied by the adhesive type and the type of adhesive user.

- Users would need to use 20% more gallons of acetone-based and methylene chloride based adhesive for the same operation compared to nPB-based or water-based adhesives because of higher volatility.
- Most users of nPB-based adhesive that would be forced to switch would be in the foam fabrication industry (NAICS code 326150) and in aircraft seating (NAICS code 336360).

Installation of spray booths:

Depending on the size of the facility, the following number of spray booths and workers are assumed.

Table 3-4 Assumptions about Workers and Ventilation Equipment For Adhesives Sector		
Number of Employees at Facility	Number of Spray Booths	Number of Workers Spraying Adhesive
1 to 4	1	2
5 to 9	3	6
10 to 19	6	12
20 to 49	8	16
50 to 99	10	20
100 to 249	14	24
250 to 499	24	48

Cost assumptions for spray booths

- \$1000 per spray booth
- 44% added on to capital costs to cover installation costs
- \$200 per spray booth for maintenance
- \$400/week/person of training in using new adhesives; two people per spray booth

Other costs specific to water-based adhesives:

- \$6000 for facilities with fewer than 100 employees, \$12,000 for facilities with 100 to 249 employees, or \$18,000 for facilities with 250 to 500 employees to pay either for driers or for extra factory space where foam parts can dry out.
- \$700 per new spray gun (one per spray booth)
- \$2800 for a new adhesive pump (one for each 15 booths)
- \$120 extra in electric utilities per spray booth/ventilation unit

Other costs specific to methylene chloride-based adhesives:

- \$11,000 for each upgraded ventilation system accompanying a spray booth, in order to meet OSHA rules for methylene chloride
- \$100 extra in electric utilities per spray booth/ventilation unit
- \$970 for a facility health monitoring program, plus \$212 per worker for personal health monitoring—costs that are likely under OSHA rules for methylene chloride
- \$116 per facility plus \$ 946 per worker for personal protective equipment—costs that are likely under OSHA rules for methylene chloride

Other costs specific to acetone-based adhesives:

- \$700 per new spray gun (one per spray booth)
- \$2800 for a new adhesive pump (one for each 15 booths)
- \$800-1000 for fire prevention equipment, such as spark arrestors
- \$50,000 per spark arrestor (roughly, one per booth) for changes to meet fire code, such as explosion proofing and electrical rewiring—costs of \$50,000 to \$1.2 million per facility
- \$500 per year in additional insurance premiums



**Table 3-5. Estimated Impacts on Small Businesses Using Adhesives If nPB Found Unacceptable,  
by NAICS Code and Category**

NAICS Code	Business Category	Typical Annual Cost of Compliance Per Small Business Switching Away from nPB	Average Annual Value of Shipments per Small Business in NAICS Category	Typical Cost of Compliance Per Small Business Switching Away from nPB as a Percentage of Sales	Number of Small Businesses Experiencing Significant Impact
336360	Motor Vehicle Seating and Interior Trim Manufacturing	-\$67,700 to -\$64,900 (savings)	\$18.3 million	-0.35% to -0.37%	0 (of 21 users)
326150	Urethane and Other Foam Product Manufacturing	\$14,600 - \$26,400	\$9.4 million	0.16% to 0.28%	0 (of 172 users)
337121	Upholstered Household Furniture Manufacturing	\$22,300 - \$29,100	\$3.3 million	0.68% to 0.88%	4 (of 49 users)
337110	Wood Kitchen Cabinet and Counter Top Manufacturing	\$18,200 - \$20,700	\$0.9 million	2.02% to 2.30%	5 (of 27 users)
337124	Metal Household Furniture Manufacturing	\$15,400 - \$18,900	\$4.1 million	0.38% to 0.46%	0 (of 11 users)
<b>Sector Average</b>	<b>-</b>	<b>\$10,100- \$19,050</b>		<b>0.13% to 0.24%</b>	<b>9 of 280 users</b>

This analysis implies that there would not be a significant impact on a substantial number of small adhesive users if EPA were to find nPB unacceptable in the adhesives end use. Upholstered Household Furniture Manufacturers, NAICS code 337121, would experience the highest average cost of conversion. Wood Kitchen Cabinet and Counter Top Manufacturing, NAICS code 337110, would experience the highest cost of conversion as a percentage of annual shipments and would have the largest number of small businesses experiencing significant adverse impacts (greater than 1% of annual sales). The average impact as a percentage of sales for NAICS code 337110 is exaggerated because the average shipments for companies using nPB are larger than the average shipments for all small companies in this NAICS code (see table 2-5).

Manufacture of aircraft seating, captured under Motor Vehicle Seating and Interior Trim Manufacturing, would experience cost savings if users are able to choose freely between water-based, flammable and methylene chloride-based adhesives. However, the Federal Aviation Administration (FAA) sets tight specifications on aircraft seating that would preclude use of flammable adhesives (e.g., acetone-based). In addition, aircraft seating manufacturers may need to receive special permission from FAA to use water-based adhesives, depending on the flammability test results. Given these hurdles, the actual cost of switching away from nPB may be higher. If users instead all switched to methylene chloride-based adhesives, the average savings per user in this NAICS code would be approximately \$25,000 per year instead of \$65,000 or more per year. The Halogenated Solvents Industry Alliance has suggested that adhesive users have sometimes chosen to use n-propyl bromide instead of methylene chloride to avoid potential liability associated with medical monitoring required by OSHA for use of methylene chloride (HSIA, 2001). In addition, companies may wish to avoid using methylene chloride, a solvent that is heavily regulated and that may be carcinogenic. These reasons may explain why end users apparently are not already implementing the least expensive option.

### Limitations and Uncertainties

The analysis in this document is based on data and estimates provided by industry representatives and experts. However, there are limitations that should be mentioned. These limitations do not call into question the results provided in this analysis, but help to identify areas where additional quantification could be undertaken. The points to consider are:

- Characterization of the number of entities using nPB in the adhesives industry is based on expert opinion. More recent information indicates that there may be fewer users of nPB-based adhesives than were considered for this analysis (as few as 40 users, as opposed to the 280 users in the analysis). This will exaggerate the number of adhesives users, the amount of adhesive used, and the total annualized cost.
- Consumption patterns and potential substitute market shares for users that consume extremely small quantities of nPB per year have not been incorporated into the analysis.
- The estimated price for the adhesives industry used in this analysis is near the high end of the range of prices seen in the past year. This will exaggerate the cost of the regulatory options.

- The analysis only examines the direct impacts of the regulatory options on end users. The analysis does not examine impacts on manufacturers of nPB or nPB-based adhesives, since EPA does not directly regulate them. Doing such an analysis would require knowing the relative profitability of nPB-based adhesives compared to other types of adhesives used in the same applications. This information is not available to EPA.
- This report does not consider the possibility that businesses may be able to pass on additional costs to consumers or that they may choose to switch to an alternative type of adhesive instead of complying with the regulatory use condition.
- This analysis does not consider the performance characteristics of different types of adhesives. Thus, if users avoid certain alternatives because of actual or perceived differences in performance, particularly for water-based adhesives, this preference is not captured in the analysis.
- This analysis does not consider the impacts of the final National Emission Standard for Hazardous Air Pollutants in Flexible Polyurethane Foam Fabrication Operations. This rule was signed by EPA's Administrator on March 7, 2003 but was not yet published or in effect as of this writing. This final rule would prevent the use of methylene chloride-based adhesives in foam fabrication.

#### *Top-down analysis*

For comparison with the detailed, "bottom-up" analysis, one can estimate the costs of meeting the regulatory options by determining the cost change and the total amount of solvent being used in the adhesives, coatings and inks sector.

nPB manufacturers in 2001 estimated 9 million lbs nPB were sold worldwide in 2000 and 2001. Their more recent, preliminary estimates for 2002 are closer to 12 million lbs and their earlier estimates were for sales of 15 million lbs in 2002. The US represents roughly 40% of the solvents market across industrialized countries. Our data indicate that nPB adhesive end-uses account for about half of the solvent sold. This is a conservative assumption, since more recent data from Poly Systems indicate that the U.S. market for nPB-based adhesives is less than 1.5 million pounds per year.

Using this "top down" approach, and making the conservative assumption that the US accounts for 40% or less of the entire world solvent market, we could derive projected US nPB sales affected by the proposed rule:

12-15 million lbs x 0.4 (US/world solvent sales) x 0.5 (nPB adhesive solvents/total nPB sales) = 2.4-3.0 million lbs

Total costs of Option A, the proposed regulatory use condition, would be approximately \$2.1 to 2.6 million based upon our assumptions. This is slightly less the costs predicted by the bottom-up analysis because of the smaller estimate of solvent usage. This is likely to be a

conservative estimate, since the most recent information on nPB use in adhesives indicates only half that amount, or 1.1 to 1.4 million lbs per year. This would reduce the cost of regulatory compliance to roughly \$ 1 to 1.3 million per year.

Total costs of Option B, a limit on iPB content of 0.025% in nPB formulations, would be \$ 3.8 to 4.8 million per year. If we use more recent estimates of the amount of nPB used in adhesives, this compliance cost would be closer to \$1.6 to 2.2 million per year.

**Table 3-6: Comparison of Costs under Regulatory Options Considered  
 (“Top-Down” Analysis)**

Regulatory Option	Date of Estimate for nPB Usage	Annual cost to the user community (2000 \$)
Option A (iPB $\leq$ 0.05%)	2001 (ICF)	\$ 2.1 to 2.6 million
Option B (iPB $\leq$ 0.025%)	2001 (ICF)	\$ 3.8 to 4.8 million
Option A (iPB $\leq$ 0.05%)	2002 (Poly Systems)	\$ 1.1 to 1.3 million
Option B (iPB $\leq$ 0.025%)	2002 (Poly Systems)	\$ 1.6 to 2.2 million

## Conclusions

There are minimal overall impacts for the adhesives sector and for industry at large due to this regulation. The total cost of compliance with the regulatory use condition is no more than \$2.9 million per year. Based on the most recent available information on the use of nPB in adhesives, this value may overestimate the annual cost by as much as \$1.7 million per year. For purposes of a “best” estimate for comparing costs, EPA will evaluate using the costs based on the “top-down” analysis, while assuming usage of 2.4 to 3.0 million pounds of nPB per year in the adhesives, coatings, and inks sector.

The annual costs of the proposed regulatory provision are all associated with a projected increase in price of nPB formulations used for adhesives. The solvent cleaning and aerosol sectors would not experience a cost increase because these markets already produce nPB formulations meeting this level of purity. EPA’s best estimate of the cost of the regulatory provision is \$2.6 million per year.

**Table 3-7: Annualized Costs of Compliance with Proposed Regulatory Provision  
(Option A, iPB Content < 0.05%)**

Industrial Sector	Average annual cost per user (\$)	Annual costs to the user community (\$ million)
Solvent cleaning	0	0
Aerosols	0	0
Adhesives, coatings and inks	10,400	2.6 (range of 1.0 to 2.9)
All		2.6 (range of 1.0 to 2.9)

#### 4. *Costs of Implementing the Recommended Acceptable Exposure Limit (AEL)*

A cost analysis of the recommended acceptable exposure limit is not expressly required for analysis of regulatory and small business impacts because it is a recommendation rather than a regulatory requirement. However, available information indicates that the recommended exposure limit is a cost-effective way of protecting public health.

##### 4.1 Costs of implementing the recommended AEL in the solvent cleaning sector

Many users of nPB solvent formulations already meet the recommended acceptable exposure limit. Petroferm and Albemarle have product stewardship programs that provide for monitoring exposure levels in the workplace. Results from this monitoring shows that roughly 75 % of users meet these companies' workplace guideline of 25 ppm during vapor degreasing. Amity UK Ltd. states in its vapor degreasing manual that, "For a properly designed, installed, operated, and maintained traditional open-top vapor degreaser, experience has shown that eight-hour time weighted operator exposure levels will be < 20 ppm. For enclosed and automated degreasers, lower exposures can be achieved." (Amity UK Ltd, 2001)

Any emission reductions made to meet the acceptable exposure limit would result in a savings to the user. If any users that did not currently meet an exposure level of 25 ppm were to change their behavior as a result of EPA's recommendation, those users would reduce the amount of solvent lost to the air through evaporation. Thus, they would save money spent on solvent. Users adding emission controls would initially have capital costs between \$700 and \$15,000, but would recover the cost after saving just 250 to 3200 lb of solvent (2.5 to 8 drums). (Sources: Email from Pamela Gormely, Thermal Equipment Corp. and Call with Rod Murphy, Degreasing Devices Company)

Typical emission rates and usage rates for batch vapor cleaners of different sizes estimated for the halogenated cleaning solvents National Emission Standard for Hazardous Air Pollutants are provided below in Table 4-1 (Radian memo, May 26, 1993). The first four columns in the table are from Table 2 in the Radian Memo (p. 7); the column for annual solvent usage is calculated from those values. This calculation assumes that small and medium cleaners operate for 2 hours per day and idle for 6 hours per day and large and very large cleaners operate for 6 hours per day and idle for 6 hours per day. The amount of solvent saved will depend on the emissions before introducing controls. For example, if a user reduced average exposure levels from 100 ppm to 25 ppm, the user would save 75% on the cost of additional solvent in any given year. At such a level of reduction, most businesses would recover the capital cost of controls within the first year.

**Table 4-1. Estimates of Typical Solvent Usage from Vapor Degreasers**

Degreaser Size	Degreaser top surface area (m <sup>2</sup> )	Fraction of solvent emitted <sup>1</sup>	Annual controlled emissions <sup>2</sup> (kg/m <sup>2</sup> *yr)	Annual solvent consumption	
				kg/yr	lb/yr
Small	0.4	0.89	1,885.1	847	1860
Medium	0.8	0.89	1,885.1	1690	3730
Large	1.5	0.89	2648.1	4460	9820
Very Large	3.5	0.89	2648.1	10,400	22,900

<sup>1</sup> Fraction of solvent emitted with current controls (Kg emitted/kg consumed)

<sup>2</sup> Annual emissions from a vapor degreaser of this size with current controls

Several suppliers of nPB have said that it costs from \$3 to 5 per pound when used in the solvent cleaning market (Presentation to 16<sup>th</sup> OORG meeting–Solvents Sector, May 2, 2000, Singh email). Based on these estimates, one can see that the cost of using nPB would range from \$ 5580 to \$114,500 per year for each vapor degreaser. For purposes of comparison, retrofit options for reducing emissions range from \$700 to install a mechanical hoist that requires pressing a button to \$8000 to install additional condensing coils to reduce evaporative losses (Call with Rod Murphy, Degreasing Devices Company).

If 75% of nPB users already meet the 25 ppm recommended exposure limit, then only 25% would retrofit their equipment and reduce their solvent costs. Individual solvent users would save from \$4180 to 85,875 in solvent costs if they reduced their emissions from 100 ppm to 25 ppm. On an annual basis, this would quickly offset the annualized capital costs of \$93 to \$1060.

Assuming that the average solvent use per year without controls is roughly 8 million pounds for 2500 users, or 3200 lb/user and the annual savings is 2400 pounds at \$4/lb, the average savings on solvent per year is \$9,600. Using this value and the assumption that only 25% of users install controls, the range of annualized cost savings would be approximately \$3.6 million. If instead one assumes a small user using 2400 lb/yr, where only 10% of solvent users must reduce their emissions, on average from 50 ppm to 25 ppm, the annualized cost savings is only \$0.1 million.

Overall, any capital costs incurred to implement the 25 ppm recommended exposure limit would be small compared to the overall cost of spending on solvent and the capital costs would soon be recovered. Thus, we conclude that there would not be a significant impact on a substantial number of small businesses.

#### 4.2 Costs of implementing the recommended AEL in the aerosols sector

Because the acceptable exposure limit is a recommendation and not a requirement, the associated costs cannot be accurately calculated. The cost of reducing exposure would be the cost of improving ventilation, such as installing a vented hood. This is a relatively small capital cost, on the order of \$550 to \$1000 (ICF Consulting Memo, 8/30/2001). Some users would already have such equipment installed.

Users of aerosol solvents generally use smaller amounts than users of non-aerosol cleaning solvents. For aerospace applications, we would expect large amounts of usage on the order of 6000 to 20,000 lb/yr. For electronics cleaning applications, we would expect a smaller amount of 200 lb/yr or less (Tattersal, 2003). The amount of aerosol cleaner used is one to two orders of magnitude lower than the amount use in vapor degreasers, as described in the previous section. We estimate that there are between 1000 and 5000 users of nPB aerosol solvents, and 900 to 4750 users that are small businesses. Thus, the range of capital costs for improving ventilation equipment by all users of nPB aerosol solvents would be in the range of \$550,000 to \$5 million if none of the users had ventilation equipment already installed. This is unlikely, since some users already have hoods installed or use a large open area with good ventilation. The annualized capital cost would range between \$ 73,200 and \$ 665,000 for the entire aerosol sector, with 90 to 95% of the expense bourne by small businesses. Based on this rather modest cost, we conclude that there also would not be a significant impact on a substantial number of small businesses.

#### 4.3 Costs of implementing the recommended AEL in the adhesives, coatings, and inks sector

In the adhesives sector, we know of only two users already attaining average exposure levels below 25 ppm, and they installed new ventilation equipment and spray booths to reduce exposure. A few users of nPB-based adhesives already have some of this equipment installed (IRTA report on adhesives). Long-term exposure is likely to be more of an issue for foam fabrication and for automotive trim, where workers spray adhesive continually over the course of the day. In contrast, contact adhesive applications, such as for countertops, are more likely to be short-term, high exposures, such as during the installation of a countertop. However, since the majority of nPB-based adhesive is used in spray adhesive applications, we can make the conservative assumption that most or all adhesive users would need to install control equipment to meet the recommended exposure limit.

If every one of the companies that ICF Consulting estimated to use nPB-based adhesives were to install new spray booths and fans, the total capital cost would be approximately \$54 to 56 million, or roughly \$8.4 million on an annualized basis.

Cost assumptions:

- Spray booths cost between \$1000 and \$1400 each.
- The number of spray booths will vary with the size of the business and the number of workers spraying adhesive. A company with fewer than 10 employees would have one to three booths, a company with 10 to 50 employees would have six to eight booths, a company



with 50 to 250 employees would have ten to fourteen booths, and a company with more than 250 employees would have twenty-four booths.

- Each new booth would have a complete, new ventilation system added at a cost of \$11,000 for equipment.
- Labor and planning costs for installation would 44% of the cost of the capital equipment.
- Adding the new equipment will cost an extra \$100 per year in utilities and \$200 per year for maintenance for each new spray booth.
- There is a discount rate of 7% and the cost of capital equipment is spread out over ten years.
- There are 280 users of nPB-based adhesives. None of them consider switching to another type of adhesive. All of them install ventilation equipment to try to meet the recommended exposure limit.

We calculated an annualized cost of meeting an AEL of 25 ppm at approximately \$8.4 million for all nPB-based adhesives users. This is based on a total capital cost of \$54 to 56 million during the first year for all users of nPB-based adhesives. If one uses the most recent estimates of the number of nPB-based adhesive users (40 to 80), this number should be closer to \$12 million of total capital costs with an annualized cost of \$1.6 million.

Note that this analysis conservatively assumes that no users of nPB-based adhesives currently have spray booths installed and all will install spray booths to try to meet the recommended exposure limit. At least 8 users of nPB-based adhesives already have spray booths installed, based upon information from the National Institute for Occupational Safety and Health and the Institute for Research and Technical Assistance (IRTA, 2000). This is between 4% and 20% of all users of nPB-based adhesives, depending on whether one uses ICF Consulting's or Poly System's estimate of the number of users. Further, some users may choose to switch to a different type of adhesive.

Because of the greater costs and small resources available in the adhesives sector, EPA analyzed the compounded impact of the regulatory use condition on isopropyl bromide content and the recommended exposure limit together.

**Table 4-2. Estimated Impacts on Small Businesses Using Adhesives from Implementation of the Recommended Acceptable Exposure Limit in Combination with Regulatory Options, by NAICS Code and Category**

NAICS Code	Business Category	Typical Annual Cost Per Small nPB User			Average Annual Value of Shipments per Small Business in NAICS Category	Typical Cost Per Small nPB User in NAICS Category as a Percentage of Sales		
		Implementing AEL	Option A + AEL	Option B + AEL		Implementing AEL	Option A + AEL	Option B + AEL
336360	Motor Vehicle Seating and Interior Trim Manufacturing	\$25,180	\$90,060	\$143,150	\$18.3 million	0.14%	0.49%	0.78%
326150	Urethane and Other Foam Product Manufacturing	\$30,560	\$39,330	\$46,500	\$9.4 million	0.33%	0.42%	0.49%
337121	Upholstered Household Furniture Manufacturing	\$30,460	\$31,390	\$32,150	\$3.3 million	0.92%	0.95%	0.97%
337110	Wood Kitchen Cabinet and Counter Top Manufacturing	\$24,180	\$24,520	\$24,800	\$0.9 million	2.69%	2.72%	2.76%
337124	Metal Household Furniture Manufacturing	\$38,830	\$39,410	\$39,880	\$4.1 million	0.95%	0.96%	0.97%
<b>Sector Average</b>	-	<b>\$29,960</b>	<b>\$40,100</b>	<b>\$48,680</b>		<b>0.38%</b>	<b>0.50%</b>	<b>0.61%</b>

Implementing AEL: installing ventilation equipment to meet an AEL of 25 ppm

Option A: isopropyl bromide content of nPB  $\leq$  0.05%

Option B: isopropyl bromide content of nPB  $\leq$  0.025%

**Table 4-3. Estimated Number of Small nPB Adhesive Users Experiencing an Impact of Greater than 1 Percent of Sales from Implementation of the Recommended Acceptable Exposure Limit in Combination with Regulatory Options, by NAICS Code and Category**

NAICS Code	Business Category	Number of Small Businesses using nPB in NAICS Category	Number of Small Businesses Experiencing >1% Impact on Sales		
			Implementing AEL	Option A + AEL	Option B + AEL
336360	Motor Vehicle Seating and Interior Trim Manufacturing	21	0	21	21
326150	Urethane and Other Foam Product Manufacturing	172	0	17	17
337121	Upholstered Household Furniture Manufacturing	49	4	4	4
337110	Wood Kitchen Cabinet and Counter Top Manufacturing	27	5	5	5
337124	Metal Household Furniture Manufacturing	11	0	0	0
<b>Sector Total</b>	-	<b>280</b>	<b>9</b>	<b>47</b>	<b>47</b>

Implementing AEL: installing ventilation equipment to meet an AEL of 25 ppm

Option A: isopropyl bromide content of nPB  $\leq 0.05\%$

Option B: isopropyl bromide content of nPB  $\leq 0.025\%$

Based on the relatively high impact on small businesses in terms of percentage of sales for upholstered furniture, metal furniture, and countertop manufacturing seen in Table 4-2, one would expect that more small businesses would experience greater than 1% of sales in Table 4-3. However, in these three NAICS codes, the annual value of shipments for the average small business in the NAICS code is substantially smaller than the annual value of shipments for the average nPB user in the same NAICS code (see table 2-5 above). For example, for metal household furniture manufacturing, NAICS code 337124, we estimate the average small business has annual shipments of \$4.1 million, but the average small business using nPB has annual shipments of \$16.9 million. For Wood Kitchen Cabinet and Counter Top Manufacturing, NAICS code 337110, the average small business has annual shipments of only \$900,000, but the average small business using nPB has annual shipments of \$2.4 million. The spreadsheet analysis summarized here compares average costs to average shipments for a particular size category of business (e.g., 50 to 99 employees), resulting in a more precise estimate of which businesses are significantly impacted.

## Conclusions

Capital costs of equipment to reduce emissions from solvent cleaning equipment are quickly repaid by the savings in solvent, typically in less than a year. Capital costs of reducing emissions from aerosols and adhesives are on the order of \$55 to 60 million, and approximately \$8.4 million on an annualized basis. This is based upon a number of highly conservative assumptions. More realistic cost estimates would be a total of \$12 million and less than \$ 1.6 million on an annualized basis, based upon the most recent available data on the market for nPB-based adhesives.

**Table 4-4: Annualized Costs of Implementing Recommended Exposure Limit**

Industrial Sector	Annualized cost per user (\$)	Annual costs to the user community (\$ million)
Solvent cleaning	-83,900 to +2,000	-0.1 to -3.6
Aerosols	124 to 1230	+0.07 to +0.67
Adhesives, coatings and inks	24,000 to 39,000	+1.6 to +8.4
All		-1.9 to +5.5

### 5. *Indirect Economic Impacts*

Other sectors of the economy will experience indirect impacts as a result of EPA's rule. All of the manufacturers and formulators of nPB located in the U.S. already sell nPB that meets the regulatory use condition on isopropyl bromide content, according to a letter from Richard Morford in his comments to the Center for the Evaluation of Risks to Human Reproduction. In the past, some foreign suppliers apparently were introducing nPB into the U.S. market that contained as much as 1.0% isopropyl bromide. A number of foreign suppliers have begun to set their product specification to require 0.05% or even as low as 0.03% isopropyl bromide in nPB formulations. Note that the suppliers legally are not required to change their formulations, although to have market share in the U.S. they will want to do so. Given that U.S. suppliers already are producing nPB meeting the use condition, there should be no further cost associated with the rule.

### 6. *Benefits*

EPA estimates the benefits of the proposal are somewhere between \$ 2.5 and 270 million. This range is wide because there is insufficient data available on both nPB and iPB, particularly human epidemiological data, that would allow us to quantify the rate of various adverse health effects due to exposure from iPB or nPB. Further, there is a wide range in the estimated number of workers exposed to nPB, between 3320 and 34,700 workers. The range of benefits above assumes

health effect rates between 5 and 50%<sup>1</sup> of the working population exposed to nPB, and unrealistically low medical costs of \$15,000<sup>2</sup> per person (1996 dollars) experiencing adverse health effects. The estimated benefits do not account for loss in worker time and increases of medical insurance premiums in the absence of regulation or an AEL recommendation.

Further, there are no data comparing human health effects at different exposure levels to nPB or iPB that could be used to estimate relative benefits of different exposure levels or different concentrations. Thus, it is impossible to separate how much of the benefits come from the regulatory restriction on iPB content and how much comes from reduced exposure to nPB as a result of the recommended exposure limit.

**Table 6-1: Annualized Benefits and Costs**

Industrial sector	Annualized cost of regulatory provision (\$ million)	Annualized cost (+) or savings (-) of implementing AEL recommendation (\$ million)	Annual health benefits (-) to the economy of proposal (\$ million)	Difference between costs and benefits (\$ million; - indicates net benefit to economy)
Solvent cleaning	0	-0.1 to -3.6	-0.8 to -63.8	-1.7 to -63.9
Aerosols	0	+0.07 to +0.67	-1.5 to -188	-1.4 to -187
Adhesives, coatings and inks	+1.0 to +2.6	+1.6 to +8.4	-0.2 to -9	-6.4 to +10.8
All	+1.0 to +2.6	-1.9 to +5.5	-2.5 to -270	+5.6 to -271

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<sup>1</sup>In NIOSH HETA 98-0153 at Custom Products, between 42 and 51% of surveyed workers reported neurological symptoms such as problems concentrating, feeling drunk while not drinking, and headache at nPB concentrations ranging from 117 ppm to 197 ppm. One worker reported seeing a doctor for reproductive problems (exposure at approximately 117 ppm) and three of 41 workers reported difficulty having children after trying for a full year (exposure from 110 to 157 ppm). In a case study of three workers exposed to n-propyl bromide, three of fifteen workers reported neurological symptoms at concentrations of 60 to 261 ppm, with an average of 133 ppm (*J. Occ. Health* 2002; 44:1-7) In a South Korean electronics factory, 16 of 25 women exposed to isopropyl bromide experienced reproductive problems such as hot flashes, disturbed menstrual cycles, and ovarian failure (exposure levels not well characterized; Kim et al, *Scand J. Work Environ.* 1996; 22: 287-291; Park et al, *J. Occup. Health* 1997, 39: 138-143; Koh, *Eur. J. Endocr.* 1998, 138:554-556.

<sup>2</sup>In vitro fertilization costs from \$6000 to \$20,000 per cycle, including medication. (See <http://www.ivf.com/globalfee.html> , <http://www.advancedfertility.com/ivfprice.htm> , <http://www.embryo.net:80/fertility-pages/fee.html> , <http://www.ivf-md.com/> ) It is not uncommon for a woman to require multiple fertilization attempts using in vitro fertilization (<http://www.ivf-md.com/>).

## 7. *Conclusions*

There is a range of costs and benefits associated with regulating nPB and with recommending an exposure limit. The costs of the proposed regulation are less than \$3 million per year. EPA also considered another, more expensive regulatory option that would have cost as much as \$5.3 million per year. EPA rejected that regulatory option as less cost-effective and having a greater impact upon small businesses. Analysis of the regulatory requirements shows that there is not a significant impact on a significant number of small entities.

The costs of both complying with the regulatory use condition (limit on iPB content of 0.05%) and implementing the recommended AEL at all facilities are between a savings of \$ -0.9 million and a cost of +8.1 million per year. The largest portion of these costs will be born by users of nPB-based adhesives, at a cost ranging from \$2.6 million to \$11 million per year. Considering the costs of both the regulatory requirement and full implementation to meet the AEL of 25 ppm, at most 48 small adhesive users, or 17% of the 280 total, would experience impacts on annual sales of 1.0 to 2.9%. None would experience impacts of 3.0% or more. Solvent users would save more money in reduced solvent costs than they would spend in reducing their emissions. The health benefits are estimated to be between \$2.5 and \$ 270 million per year. EPA concludes that the overall benefits of the proposal outweigh the costs, and probably outweigh them significantly.

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## Appendix A: Details of Small Business Impact Analysis in the Adhesives Sector

For each of the sectors currently using nPB in the adhesives industry, an analysis was performed to quantify the number of small entities experiencing a negative economic impact under the two regulatory options. Option A indicates a use condition requiring nPB containing less than 0.05% isopropyl bromide; Option B limit isopropyl bromide content to 0.025%. Using criteria established by 1999 Revised RFA/SBREFA Guidance for EPA Rulewriters (EPA 1999), entities incurring an economic impact of greater than 1 percent of sales were potentially considered to be adversely impacted. This is a conservative use of EPA's criteria; a criterion of 3 percent of sales is also mentioned in the Guidance. This section presents the results of the analysis for each adhesives end use sector using a 1 percent threshold. Costs for all regulatory options are presented relative to a baseline of continued use of nPB at the current price (i.e., all economic impacts are represented as a percent change from continued use of nPB at its current price with no imposed regulation). nPB use in the adhesives sector is divided as follows:

- 98 percent of the total nPB used by end users is used by manufacturers of seating and cushions (49 percent to NAICS code 326150 and 49 percent to NAICS code 336360).
- The remaining 2 percent is divided among the other sectors in the analysis (1.5 percent to NAICS code 337121, 0.3 percent to NAICS code 337110, and 0.2 percent to NAICS code 337124)

### A. Motor Vehicle Seating and Interior Trim Manufacturing (NAICS Code 336360)

The motor vehicle seating and interior trim manufacturing sector was modeled to comprise nearly half of the n-propyl bromide used by end users in the adhesives industry. Since low and high cost scenarios are extremely similar, results of analysis on high cost regulatory options A and B are presented in Tables 3-4 and 3-5, below. All of the 21 small companies currently using nPB for this end use would suffer significant economic impact if limitations were placed on iPB content of nPB at a level of 0.025% (Option B). Total compliance costs across all employment categories under regulatory option A would be approximately \$107,800. Total compliance costs across all employment categories under regulatory option B would be approximately \$196,000.

Under Option A, the average impact on the 14 small businesses with 50 to 99 employees was 0.96% of annual value of shipments. Although the analysis indicates that no businesses would experience a substantial adverse impact, because the annual value of shipments is averaged among 14 businesses, it is possible that some individual businesses experience an impact of greater than 1%. Thus, EPA considers this analysis to show that between 0 and 13 small businesses may experience a substantial impact of greater than 1% of annual sales under Option A.

Table App-1. Results of Small Business Impact Analysis for NAICS Code 336360,  
Option A (iPB≤0.05%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Economic Impact
1 to 4	0	174,500	\$0	0.00%	0
5 to 9	0	532,875	\$0	0.00%	0
10 to 19	0	2,490,455	\$0	0.00%	0
20 to 49	7	3,901,979	\$21,560	0.55%	0
50 to 99	14	8,981,786	\$86,240	0.96%	0
100 to 249	0	44,153,730	\$0	0.00%	0
250 to 499	0	100,579,000	\$0	0.00%	0

Table App-2. Results of Small Business Impact Analysis for NAICS Code 336360,  
Option B (iPB≤0.025%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	174,500	\$0	0.00%	0
5 to 9	0	532,875	\$0	0.00%	0
10 to 19	0	2,490,455	\$0	0.00%	0
20 to 49	7	3,901,979	\$39,200	1.00%	7
50 to 99	14	8,981,786	\$256,800	1.75%	14
100 to 249	0	44,153,730	\$0	0.00%	0
250 to 499	0	100,579,000	\$0	0.00%	0

## B. Urethane and Other Foam Product Manufacturing (NAICS Code 326150)

This sector comprises nearly half of n-propyl bromide used by end users in the adhesives industry. Since low and high cost scenarios are extremely similar, results of analysis on high cost regulatory options A and B are presented in Tables 3-6 and 3-7, below. Tables 3-6 and 3-7 show that 17 companies (approximately 10 percent of small entities using nPB in this sector) would experience a significant impact under regulatory option B, while none would experience a significant impact under regulatory option A. Total compliance costs across all employment categories under regulatory option A would be approximately \$54,407, while total costs under regulatory option B would be approximately \$98,922.

Table App-3. Results of Small Business Impact Analysis for NAICS Code 326150,  
Option A (iPB $\leq$ 0.05%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	287,744	\$0	0.00%	0
5 to 9	0	1,211,200	\$0	0.00%	0
10 to 19	0	2,537,028	\$0	0.00%	0
20 to 49	17	5,892,653	\$44,388	0.75%	0
50 to 99	85	11,608,984	\$ 3,551	0.03%	0
100 to 249	70	26,480,552	\$6,468	0.02%	0
250 to 499	0	59,104,111	\$0	0.00%	0

Table App-4. Results of Small Business Impact Analysis for NAICS Code 326150,  
Option B (iPB $\leq$ 0.025%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	287,744	\$0	0.00%	0
5 to 9	0	1,211,200	\$0	0.00%	0
10 to 19	0	2,537,028	\$0	0.00%	0
20 to 49	17	5,892,653	\$80,706	1.37%	17
50 to 99	85	11,608,984	\$6456	0.06%	0
100 to 249	70	26,480,552	\$11,760	0.04%	0
250 to 499	0	59,104,111	\$0	0.00%	0

### C. Upholstered Household Furniture Manufacturing (NAICS Code 337121)

This sector comprises approximately 1.5 percent of the n-propyl bromide used by end users in the adhesives industry. High cost scenario results of analysis on regulatory options A and B are presented in Tables 3-8 and 3-9. As Tables 3-8 and 3-9 indicate, no small companies using nPB in this sector would experience a significant negative economic impact under options A and B. Total compliance costs across all employment categories under regulatory option A would be approximately \$2,457. Total compliance costs across all employment categories under regulatory option B would be approximately \$4,467.

Table App-5. Results of Small Business Impact Analysis for NAICS Code 337121,  
Option A (iPB≤0.05%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Economic Impact
1 to 4	0	135,545	\$0	0.00%	0
5 to 9	0	428,646	\$0	0.00%	0
10 to 19	4	913,225	\$165	0.02%	0
20 to 49	4	2,582,340	\$330	0.01%	0
50 to 99	16	5,680,148	\$536	0.01%	0
100 to 249	25	14,832,151	\$1426	0.01%	0
250 to 499	0	34,893,895	\$0	0.00%	0

Table App-6. Results of Small Business Impact Analysis for NAICS Code 337121,  
Option B (iPB≤0.025%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	135,545	\$0	0.00%	0
5 to 9	0	428,646	\$0	0.00%	0
10 to 19	4	913,225	\$300	0.02%	0
20 to 49	4	2,582,340	\$600	0.03%	0
50 to 99	16	5,680,148	\$975	0.02%	0
100 to 249	25	14,832,151	\$2590	0.02%	0
250 to 499	0	34,893,895	\$0	0.00%	0

#### D. Wood Kitchen Cabinet and Counter Top Manufacturing (NAICS Code 337110)

This sector comprises less than one percent of the n-propyl bromide used by end users in the adhesives industry. High cost scenario results of analysis on regulatory options A and B are presented in Tables 3-10 and 3-11. As Tables 3-10 and 3-11 indicate, 5 of the 27 small companies using nPB in this sector would experience a significant negative economic impact under regulatory options A and B. Total compliance costs across all employment categories under regulatory option A would be approximately \$1,351. Total compliance costs across all employment categories under regulatory option B would be approximately \$2,456.

Table App-7. Results of Small Business Impact Analysis for NAICS Code 337110,  
Option A (iPB≤0.05%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	135,046	\$0	0.00%	0
5 to 9	0	457,310	\$0	0.00%	0
10 to 19	5	1,015,967	\$92	0.01%	5
20 to 49	11	2,326,857	\$252	0.01%	0
50 to 99	7	5,655,585	\$660	0.01%	0
100 to 249	4	16,139,988	\$346	0.00%	0
250 to 499	0	47,943,433	\$0	0.00%	0

Table App-8. Results of Small Business Impact Analysis for NAICS Code 337110,  
Option B (iPB≤0.025%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	135,046	\$0	0.00%	0
5 to 9	0	457,310	\$0	0.00%	0
10 to 19	5	1,015,967	\$168	0.02%	5
20 to 49	11	2,326,857	\$458	0.02%	0
50 to 99	7	5,655,585	\$1200	0.02%	0
100 to 249	4	16,139,988	\$630	0.00%	0
250 to 499	0	47,943,433	\$0	0.00%	0

# E. Metal Household Furniture Manufacturing (NAICS Code 337124)

This sector comprises less than one percent of the n-propyl bromide used by end users in the adhesives industry. High cost scenario results of analysis on regulatory options A and B are presented in Tables 22 and 23. As shown in Tables 3-12 and 3-13, none of the small entities in this sector that currently use nPB will suffer a negative economic impact as a result of regulatory action that restricts the use of nPB. Total compliance costs across all employment categories under regulatory option A would be approximately \$560, while total costs under regulatory option B would be approximately \$1018.

Table App-9. Results of Small Business Impact Analysis for NAICS Code 337124,  
Option A (iPB≤0.05%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	170,820	\$0	0.00%	0
5 to 9	0	582,725	\$0	0.00%	0
10 to 19	0	1,299,671	\$0	0.00%	0
20 to 49	0	3,730,479	\$0	0.00%	0
50 to 99	0	7,522,129	\$0	0.00%	0
100 to 249	11	16,911,474	\$560	0.00%	0
250 to 499	0	33,330,714	\$0	0.00%	0



Table App-10. Results of Small Business Impact Analysis for NAICS Code 337124,  
Option B (iPB $\leq$ 0.05%)

Number of Employees	Number of Small Entities Using nPB	Average Value of Shipments Per Small Entity	Annualized Compliance Cost Per Small Entity	Economic Impact	Number of Small Entities Experiencing Substantial Economic Impact
1 to 4	0	170,820	\$0	0.00%	0
5 to 9	0	582,725	\$0	0.00%	0
10 to 19	0	1,299,671	\$0	0.00%	0
20 to 49	0	3,730,479	\$0	0.00%	0
50 to 99	0	7,522,129	\$0	0.00%	0
100 to 249	11	16,911,474	\$1018	0.01%	0
250 to 499	0	33,330,714	\$0	0.00%	0